CLAIMS

Therefore, having thus described the invention, at least the following is claimed:

1. A device for grasping and supporting a live object, the device comprising:

a pair of counter rotating supporting structures, each supporting structure including an upper portion and a lower portion, and wherein the upper portion and the lower portion each include a plurality of apertures disposed therein;

a compliant finger disposed within each of the plurality of apertures, the pair of counter rotating supporting structures are further configured to provide an opening for receiving the live object and wherein the compliant fingers are further configured to support and constrain a body of the live object; and

a speed control module for controlling the speed and timing of the rotation of the supporting structures.

2. The device of claim 1, wherein each compliant finger further comprises a structural rigidity between approximately 0.08 Nm^2 and approximately 0.35Nm^2.

3. The device of claim 1, wherein the lower portion of the supporting structure is further configured to include at least three compliant fingers each disposed in an individual aperture for supporting a body of the live object.

4. The device of claim 3, wherein the upper portion of the supporting structure is further configured to include at least two compliant fingers for constraining the body of the live object from above.

5. The device of claim 4, wherein the three compliant fingers each disposed in an aperture in the lower portion of the supporting structure further comprises a first finger of a first length, a second finger of a second length and a third finger of a third length.

6. The device of claim 5, wherein the two complaint fingers each disposed in an aperture in the upper portion of the supporting structure further comprises a fourth finger of a fourth length and a fifth finger of a fifth length.

7. The device of claim 1, wherein the compliant fingers disposed in the plurality of apertures in the upper portion of the supporting structure incline downward and the compliant fingers disposed in the plurality of apertures in the lower portion of the supporting structure incline upward.

8. The device of claim 1, wherein the compliant fingers comprise a rubber material.

9. The device of claim 1, wherein the speed control module is further configured to synchronize the rotation of the supporting structures with a conveyor transporting the live object.

10. The device of claim 1, wherein the speed control module is further configured to vary the x-translational speed of the live object while constraining the body in the compliant fingers.

11. The device of claim 10, further comprising a conveyor for transporting the live object towards the pair of counter rotating supporting structures, the conveyor further comprises a pallet assembly having a perch bar movably affixed to the conveyor, and wherein the perch bar is configured to receive the live object.

12. The device of claim 11, further comprising a shackle movably affixed to the perch bars, the shackle having a pair of grippers for gripping extended legs of the live object, and wherein when the perch bar declines under the shackle, the set of compliant fingers of the pair of counter rotating supporting structures constrains the live object therein.

13. The device of claim 12, wherein the speed control module controls the timing of the rotation of the supporting structures such that the rotation of the supporting structures is synchronized with the movement of the pallet assembly.

14. The device of claim 12, wherein the speed control module controls the timing of the rotation of the supporting structures in relation to the speed of the conveyor such that the rotation of the supporting structures moves the live object from the compliant fingers of the pair of counter rotating supporting structures at a specified rate.

15. The device of claim 1, wherein the pair of counter rotating supporting structures are further configured to rotate at a same speed.

16. A method for grasping live objects, the method comprising the steps of:

receiving an isolated live object in rotating hands;

grasping the isolated live object by sets of fingers disposed on the rotating hands; and

supporting the isolated live object with the sets of fingers.

17. The method of claim 16, further comprising the step of constraining the isolated live object by the sets of fingers to prevent the isolated live object from escaping upward.

18. The method of claim 16, further comprising the step of controlling the speed and timing of the rotation of the rotating hands in relation to speed of a conveyor.

19. A device for receiving an isolated live object, the device comprising:

a rigid member having a first end, a second end, and a middle section, the middle section being disposed between the first end and the second end; and

perch bars flexibly affixed to the middle section of the rigid member.

20. The device of claim 19, wherein the compliant perch bars are cylindrically shaped, and each compliant perch bar being configured to include longitudinal grooves.

21. The device of claim 19, wherein each of the perch bars is covered with a rubber material.

22. A system comprising:

a pallet assembly having a perch bar supporting structure, the perch bar supporting structure including perch bars;

a shackle assembly movably affixed to the pallet assembly, the shackle assembly comprising a pair of compliant grippers;

a trap bar assembly, the trap bar assembly rotatably affixed to the pallet assembly;

a shackle control mechanism affixed to the shackle assembly, the shackle control mechanism configured to lock and release the shackle assembly from the pallet assembly; and

a trolley affixed to the pallet assembly.

23. The system of claim 22, wherein the pallet assembly is configured to include rollers for traversing on a conveyor, the pallet assembly further being configured to travel along a separate track of the conveyor from a track of the conveyor utilized by the trolley.

24. The system of claim 23, wherein the conveyor further comprises a drop cam.

25. The system of claim 24, wherein the trolley is configured to move along the drop cam in a z-translational direction while continuing to travel in the x-translation direction.

26. The system of claim 24, wherein the shackle control mechanism further comprises a shackle stopper and a shackle releaser, and wherein the shackle stopper and shackle releaser provide for a move or stop control in both an x and z-direction.

27. The system of claim 26, wherein the shackle assembly further comprises a shackle and an x-translational guide, the x-translational guide configured to provide for forward and backward movement of the shackle in the x-translation direction relative to the pallet assembly, and movement of the shackle in the z-direction to stay above the pallet assembly when the trolley of the pallet assembly moves along the drop cam.

28. The system of claim 26, wherein the shackle assembly further comprises an x-motion guide configured to mount a trap-bar cam profile, magnetic lock and linear bearings that guide the shackle assembly in an x-direction, and z-motion guide rods on which the pair of compliant grippers and a shackle motion-control rod are affixed.

29. The system of claim 22, further comprising a back panel affixed to a rear portion of the pallet assembly.

30. The system of claim 22, wherein the trap bar assembly comprises a magnetic lock, a roller and a cam, and the trap bar assembly is configured to rotate along an axis that is fixed with respect to the pallet assembly.

31. The system of claim 22, further comprising a pair of counter rotating supporting structures for receiving a live object deposited onto the pallet assembly, each supporting structure includes an upper portion and a lower portion each having a plurality of apertures disposed therein, and wherein the pair of counter rotating supporting structures are further configured to provide an opening for receiving the live object, and compliant fingers disposed within the apertures of each supporting structure, the compliant fingers are further configured to support and constrain a body of the live object.

32. The system of claim 31, further comprising a speed control module for controlling the speed and timing of the rotation of the supporting structures in relation to movement of the conveyor.

33. An automated feet gripping system, comprising:

a pallet assembly for locking and releasing an isolated live object, the pallet assembly including a perch bar for receiving the isolated live object;

a conveyor for transporting the pallet assembly, the conveyor further configured to include a drop-cam for lowering the pallet assembly;

a pair of rotating hands having fingers for constraining the isolated live object while the pallet assembly is lowered;

a shackle assembly movably affixed to the pallet assembly, the shackle assembly further configured to receive feet of the isolated live object from perch bars when the pallet assembly is lowered and to shackle the feet of the isolated live object in the shackle assembly;

a first speed control module for controlling the speed of a conveyor; and

a second speed control module for controlling the speed and timing of the rotation of the pair of rotating hands in relation to speed of the conveyor.

34. The system of claim 33, wherein the conveyor further comprises an inverter portion that follows an inversion path for inverting the isolated live object shackled in the shackle assembly.

35. The system of claim 34, wherein the first speed control module and the second speed control module add claim to speed profile

36. A method for shackling a plurality of live objects, comprising:

preventing movement of a shackle assembly in an x-direction;

lowering a pallet assembly movably affixed to the shackle assembly to a pre-specified height;

driving feet of the live object into a pair of grippers of the shackle assembly; and

rotating a trap bar rotatably affixed to the pallet assembly to constrain the feet of the live object.

37. The method of claim 36, further comprising the step of:

moving the pallet assembly while the trap bar is rotating; and

locking a shackle of the shackle assembly to the pallet assembly.

38. The method of claim 37, further comprising the steps of:

releasing the pallet assembly having the live object constrained in the shackle from the shackle assembly; and

continuing transporting the pallet assembly, shackle and live object along an inversion path of a conveyor.

39. A method for transporting live objects, the method comprising:

transporting a live object along the conveyor at a predetermined rate;

rotating a pair of support structures at a rate proportional to the predetermined rate of the conveyor;

driving the live object into a shackle assembly using the rotating pair of support structures;

securing the live object in the shackle assembly;

ejecting the live object from the pair of support structures;

inverting the live object;

further transporting the inverted live object along the conveyor; and

releasing the live object.

40. The method of claim 39 further comprising the step of:

detecting entry of a live object onto the conveyor.

41. The method of claim 39 further comprising the step of:

determining a distance of the live object from a pair of support structures; and

wherein the pair of support structures are rotated in response to determining the distance of the live object from the pair of support structures.

42. The method of claim 39 further comprising the step of:

further rotating the pair of support structures at a rate faster than the predetermined rate of the conveyor, the pair of support structures being further rotated substantially concurrently with the ejecting of the live object from the pair of support structures.

43. A quick-release system comprising:

a first assembly having:

teeth; and

a first set of magnets having a first arrangement of polarities; and

a second assembly having:

clasps configured to open and close, the clasps further being configured to close on the teeth, the closing of the clasps resulting in a secure engagement of the clasps and the teeth; and

a second set of magnets configured to engage the first set of magnets, the second set of magnets having a second arrangement of polarities, the second arrangement of polarities being configured to attract the first set of magnets when the clasps are closed, the second arrangement of polarities being configured to repel the first set of magnets when the clasps are open.

44. The system of claim 43, further comprising:

a spring coupled to the first assembly, the spring being configured to provide a compliance between the first assembly and the second assembly.

45. A feet-gripping system comprising:

a perch bar having a z-direction compliance, the z-direction being a direction along a superior-inferior axis of a live object, the perch bar being configured to support a live object;

grippers having a y-direction compliance, the y-direction being a direction along a lateral axis of the live object, the grippers being configured to support a live object; and

first assembly comprising a spring, the first assembly having an x-direction compliance, the x-direction being a direction along an anterior-posterior axis of the live object.